Assessing Impact of Energy Management on Sustainable Development in Oil and Gas Sector of India: Mediation Effect of Energy Efficiency

Synopsis

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1. Introduction

1.1 Energy Management

Energy management is the process of planning, controlling, and optimizing the use of energy resources to meet the needs of society and the environment (IEA, 2022). Energy management has been accepted worldwide as playing a vital role in the promotion of sustainable development. The orthogonal issues of sustainable development, such as economic growth, social development and conflicts, and deterioration of resources and environment have been explored in view of the world's energy situation. Energy management is the proactive, organized and systematic coordination of procurement, conversion, distribution and use of energy to meet requirements, taking environmental and economic objectives into account (Energy Management, Wikipedia, 2016).

According to ISO 50001, energy management aims to improve an organisation's energy performance. That means to reach measurable results of energy efficiency, energy use and energy consumption. the standard is arranged into existing management systems. It is based on a continual improvement process following the PDCA cycle (Plan-Do-Check-Act) and the integration of (energy)management in the organisation's daily operations

The energy management programme of an organisation lays the groundwork for improvement and offers direction for controlling energy across the board. The opportunities for improvement of energy efficiency may not be discovered, promoted, or executed in organisations without a clear energy management program in place due to organisational impediments (Worrell & Galitsky, 2005). The alternative to conventional energy cost reduction techniques that involve less investment and may be deployed more quickly is the implementation of an energy management and optimization system for the current energy assets. The prediction of future energy demand based on the system's current knowledge is a crucial early stage in any energy management cycle. One of the most efficient and economical ways to increase energy efficiency is to change how energy is managed by putting in place an organization-wide energy management program.

Energy management practices encompass a range of strategies, techniques, and procedures

deployed by individuals, organizations, or governments to exert control, enhance efficiency, and preserve energy resources. These practices are designed to curtail energy consumption, boost energy efficiency, and mitigate the environmental consequences linked to energy production and utilization. Common practices encompass conducting energy audits to evaluate current usage patterns, implementing energy-efficient technologies, integrating renewable energy sources, installing real-time energy monitoring systems, promoting energy-conscious behaviours, establishing conservation programs, adhering to energy-related regulations, fostering awareness through education and training, benchmarking energy performance, optimizing energy procurement, participating in demand response initiatives, and maintaining an ongoing commitment to continuous improvement. These practices are pivotal in reducing energy expenditures, mitigating environmental impact, and securing a sustainable energy future.

Many companies have created and put into place formal energy management systems that aim to include efficiency gains. The strong management system implementation can offer the rigour and discipline required to promote continuous sustainable development. The planning and running of energy-related production and consumption units are included in energy management. Resource conservation, climate protection, and cost reduction are the goals, and users have constant access to the energy they require, which is strongly related to production management, logistics, environmental management, and other well-established corporate tasks (Mahinroosta, 2013).

1.1.1 Social dimensions

The social dimension of sustainability encompasses the elements that pertain to individuals. This includes workers, consumers, suppliers, shareholders, the community, and others who play a substantial role in shaping a company's present and future capabilities to operate effectively.

Ajmal et al. (2017) provided valuable insights into the company's viewpoint on social dimensions, which contributed to a clearer understanding of the study. This paper provides a comprehensive overview of social dimensions that hold significance and relevant in almost all the considers the well-being of employees, consumers, communities, and society as a whole. By embracing these principles, the Oil and gas sector can play a vital role in shaping a market that

prioritizes fairness and ethical practices.

Figure 1. Social sustainability indicators from companies 'perspective. (Source: Ajmal et al., 2017*)*

1.1.2 Economic dimensions

Economic sustainability entails adopting strategies that enable a company or an entire nation to achieve long-term financial growth and prosperity. Simultaneously, it requires ensuring that such growth does not have adverse impacts on the environment, social well-being, or cultural values. It's about finding a balance between generating profit and success while being environmentally responsible and taking care of people. Economic sustainability is of paramount importance to businesses because they cannot sustain long-term growth if they deplete Earth's resources or mistreat individuals. In today's context, businesses cannot continue to harm the environment or negatively impact their communities in pursuit of profits over time, as such actions would create challenges that hinder their continued success.

Through the disclosure of comprehensive and varied sustainability information, companies have the opportunity to enhance their transparency, bolster their corporate reputation, solidify their legitimacy and brand worth, mitigate information imbalances, inspire managers and employees, and overall, enhance their corporate image (Kilic, Kuzey, & Uyar, 2015).

1.1.3 Environmental dimensions:

Environmental sustainability is all about maintaining a healthy balance in nature. It means making choices and taking actions that prioritize protecting our natural world, especially ensuring that the environment can continue to support human life. Businesses, that are known for having a big impact on the environment, are expected to play a leading role in promoting environmental sustainability. Their influential position gives them the power to make significant changes. When businesses take responsibility for using sustainable practices, they set an example and can make a big difference in preserving the environment. This collective effort not only reduces their negative impact on the environment but also inspires a broader movement toward a more balanced coexistence with nature.

Numerous research studies have delved into the realm of environmental sustainability, dissecting it into three primary components: Climate Change, Waste Management, and Energy Resources. Additionally, this comprehensive perspective includes seven categories of environmental impact, encompassing climate change, acidification, ozone layer depletion, eutrophication, chemical pollution, freshwater consumption, and alterations in biosphere integrity and biodiversity (Dong & Hauschild, 2017)**.**

1.2 Energy Efficiency

Energy is undoubtedly one of the most crucial commodities for evaluating the effectiveness and performance of any industry. Saving energy through improved efficiency and conservation has a central role in reconciling economic development goals, energy security, and environmental protection. Energy efficiency is a measure of how effectively a company uses energy to produce goods or provide services. By implementing green accounting practices that focus on energy efficiency, companies can reduce their energy consumption, lower their environmental impact, and improve their financial performance (Deb et al., 2022).

Sustainable development encompasses the progress of nations while taking into account economic, social, and environmental factors. Within this framework, efficient energy utilization holds significance due to its multifaceted impacts on the economy, society, and the environment. Thus, energy efficiency plays a crucial role in securing the path to sustainable

development (Türkoğlu & Kardoğan, 2018).

1.3 Sustainable Development

The definition of sustainable development, as given by the World Commission on Environment and Development (WECD), is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The Sustainable Development Goals (SDGs) aim to transform our world. They are a call to action to end poverty and inequality, protect the planet, and ensure that all people enjoy health, justice, and prosperity. It is critical that no one is left behind (“Sustainable Development Goals,” 2021).

Sustainable Development is currently regarded as a fundamentally human endeavour, aiming to achieve progress while safeguarding the needs of future generations. The sphere where humanity resides is commonly termed the "Environment," and all activities undertaken to improve lives within this habitat are referred to as "Development." These two aspects are intricately connected, with Sustainable Development representing a dual commitment to prioritize both Environment and Development. This ideology underscores the importance of sustaining Nature (earth and biodiversity), Life Support (ecosystems, resources, and the environment), and Communities, alongside fostering the development of people, society, and the economy. The approach to sustainable development serves as a strategic solution for addressing these challenges while concurrently promoting development. Historical records demonstrate that economic development has been the pathway to independence for nations, emphasizing its ongoing significance in navigating the global landscape.

1.3.1 Sustainable Development Goals

The world is experiencing unparalleled human expansion and development, and human activity has expanded to include all of the environmental components. To protect the environment and human life, however, both natural resources and human activities must act ethically and sustainably. The Paris Agreement on Climate Change (PACC) and the 2030 Agenda for Sustainable Development are two notable examples of landmarks in how international policy has shaped the environment. The latter has established the seventeen Sustainable Development Goals (SDGs) as a common ground and a guide for world peace and prosperity (Obaideen et al.,

2022).

Table 1: SDGs and their focus areas

S. NO.	GOALS	FOCUS AREAS
SDG 1	**No Poverty**	The main aim of this goal is to eliminate poverty in all its forms. It also aims to provide basic needs to all the people and bring out them from the vulnerable and vicious circles of poverty.
SDG 2	**Zero Hunger**	This goal focuses on removing all dimensions of malnutrition and increasing agricultural productivity. Enhancing the sustainable ways of production, maintaining the ecosystem and improving cultivation techniques.
SDG 3	**Good Health and Well-being**	The goal emphasizes reducing the maternal mortality ratio and strengthening the prevention and treatment measures for premature mortality. It also promotes mental health and well-being by providing the availability of good medicines and vaccinations.
SDG 4	**Quality Education**	Education is an important contributor to development. This goal aims at ensuring quality education for all without any discrimination.
SDG 5	**Gender Equality**	Equality should be there and no disparities with reference to gender should exist. Women should get equal rights in education, and political empowerment and should not be in any case of violence and enjoy the same liberty as males.
SDG 6	**Clean Water and Sanitation**	Water is a basic necessity for the existence of life. Thus, this goal aims at providing clean water in both ways quality and quantity-wise. Also, to provide access to proper sanitation facilities.
SDG 7	**Affordable and Clean Energy**	This is an approach towards clean resources and sources of energy, available at affordable rates.
SDG 8	**Decent Work and Economic Growth**	The ultimate goal is to achieve economic growth in sustainable ways; thus, everyone should have access to work opportunities. Adequate establishment of industries and MSMEs should be there for employment generation.
SDG 9	**Industry, Innovation, and Infrastructure**	This goal is an attempt to promote sustainable industrialization using environment-friendly techniques to enhance production. Building small-scale industries with financial assistance.
SDG 10	**Reduced Inequality**	There should not be any inequalities within the country and among the countries on the basis of rich-poor criterion.
SDG 11	**Sustainable Cities and Communities**	Building cities and communities by preserving the natural heritage and providing safe and amenities inclusive habitats to live in.
SDG 12	**Responsible Consumption and Production**	The responsibility lies in both production and consumption. This goal focuses on various ways to prevent overuse and promote reuse, recycling and reduce techniques.
SDG 13	**Climate Action**	The threats of climate hazards need to be rectified immediately thus this goal emphasizes creating awareness about climate change and adapting ways to protect it and also to strengthen the facilities to cover natural hazards.
SDG 14	**Life below Water**	There should not be any marine pollution and life underwater should be protected by not contaminating it is the motive of

		this goal. Taking special measures in regard to overfishing and promoting scientific methods to improve water life.
SDG 15	**Life on Land**	The most important is to conserve wildlife, the ecosystem and the whole biodiversity. This goal also works in order to the restoration of territorial life, quality of soil, and degraded land due to deforestation and enhance the capacity of natural resources to enable sustainable development.
SDG 16	**Peace and Justice Strong Institutions**	Reducing all types of violence in the form of trafficking, abuse and exploitation of any age group is the main concern of this goal. This includes a strong legal framework and access to justice by all.
SDG 17	**Partnerships to achieve the Goal**	This is the main factor as these targets can be achieved only through the combined and integrated efforts of all countries together.

(Source: Sustainable Development Goals Basel Report, 2016)

Sustainable Development Goal 7 (SDG 7) envisions universal access to affordable, reliable, and modern energy while promoting the oil and gas sector's transition towards cleaner, more efficient practices. This involves expanding energy access for underprivileged communities, integrating renewable sources to diversify the energy mix, enhancing industry-wide energy efficiency, reducing greenhouse gas emissions through innovative technologies and sustainable approaches, and fostering responsible operations that prioritize environmental preservation and community well-being.

The oil and gas industry’s operations and products potentially have positive and negative impacts on a range of areas covered by the SDGs, including on communities, ecosystems, and economies. The industry contributes to sustainable development in several ways. These include generating direct and indirect jobs; supplying access to energy that enables economic activity and social development; contributing substantial tax and other types of revenue to governments; enabling the development of advanced technologies and products through investment in research and development; encouraging local content and entrepreneurship with associated capacity building benefits; investing in the long-term social and economic success of the communities in which they operate; and managing the impacts of its operations by emphasizing environmental protection, health and safety, and human rights.

1.4 Industry Profile

The oil and gas sector is among the eight core industries in India and plays a major role in

influencing the decision-making for all the other important sections of the economy. According to the India Brand Equity Foundation (IBEF), the country's crude oil imports rose sharply to US$ 120.4 billion in the Financial year (FY) 2022. India retained its spot as the third-largest consumer of oil in the world in 2022, with consumption of oil increasing from 3.96 million barrels per day (MBPD) in 2021 to 4.24 million barrels per day (MBPD) in 2022.

India’s economic growth is closely related to its energy demand; therefore, the need for oil and gas is projected to increase, thereby making the sector quite conducive for investment. The Government has adopted several policies to fulfil the increasing demand. The government has permitted 100% foreign direct investment (FDI) in several industry categories, including refineries, natural gas, and petroleum products, among others. Today, it attracts both domestic and foreign investment, as attested by the presence of companies such as Reliance Industries Ltd. (RIL) and Cairn India.

1.5 Profile of Oil and Gas Companies

The present study proposes to select five companies from the Oil and Gas sector of India listed in the S&P BSE Index 2022.

Bharat Petroleum Corporation Limited (BPCL)

The Bharat Petroleum Company is among the top three, effectively turning over more than 67 billion Dollars. It is a more recommended company as it is quite affordable compared to its competitors, and has its headquarters in Bangalore. The company aims to provide the finest quality Oil, gas, and Petroleum Products tested after a thorough manufacturing process in India and overseas. It belongs to the category of a publicly-owned industry with around 12,000+ employees. The head office of Bharat Petroleum is located in Mumbai, Maharashtra. The company has two major refineries, situated in Mumbai and Cochin. The company was ranked in the Fortune 500 global list and is also 44th among the Top 250 Global Energy Companies by Platts. It is also another undertaking of the Government of India.

Oil and Natural Gas Corporation (ONGC)

Oil And Natural Gas Corporation, a Maharatna company, stands as India's largest entity in crude oil and natural gas, making a substantial 75% contribution to the country's domestic

production. With over 27,000 employees, it is a prominent player in the oil and gas sector nationally, and it holds the distinction of being the largest among all government undertakings in the oil and natural gas sector. Globally, the company holds the 14th position among the Top 250 Global Energy Companies (Platts). Impressively, it is the sole Indian public-sector company to secure a spot in Fortune's esteemed list of 'Most Admired Energy Companies'. In the Forbes Global 2000 list for 2022, ONGC achieved an overall ranking of 158th. Noteworthy for its exemplary Corporate Governance practices, ONGC claims the 26th spot among prominent publicly traded global giants as recognized by Transparency International. It's an industry leader in exploration and production (E&P) on a global scale, displaying remarkable profitability and dividend returns. ONGC stands out for its comprehensive in-house capabilities spanning every facet of E&P in the oil and gas domain, along with related oil-field services.

Indian Oil Corporation Limited (IOCL)

Indian Oil Corporation Limited (referred to as Indian Oil) is a state-owned oil and gas firm headquartered in New Delhi, India. It holds the 94th position on the Fortune Global 500 list, being the largest public corporation in India in terms of revenue. Platts ranks it 25th among the Top 250 Global Energy Companies. With a substantial 13,400 km of refined product pipeline in India, Indian Oil Corporation (IOC) dominates the segment with a 49.99% share as of August 1, 2022. Established in 1959, Indian Oil Corporation holds the top position, boasting over 31,000 employees. As a public sector undertaking, its influence extends globally, with subsidiaries in Sri Lanka, Mauritius, and the UAE.

Hindustan Petroleum Corporation Limited (HPCL)

HPCL is an Indian state-owned oil and natural gas company with its headquarters functioning in Mumbai and having gained Navratna status. It is a subsidiary of Oil and Natural Gas Corporation (ONGC) Limited (ONGC), which is the largest oil and gas exploration and production company in India. This company is a state-owned oil and natural gas company whose head office is located in Mumbai, Maharashtra. The company has more than 9600 employees and a business turnover of US$59 billion. It was founded in the year 1974. The Government of India owns 54.90% of the company and is also listed 26th rank among the Top

250 Global Energy Companies by Platts. Mr. Pushp Kumar Joshi is Chairman and Managing Director of the company. It is among the top three companies that contribute to more than 80% of the total length of the product pipeline network in the country (IBEF report 2023).

Gas Authority of India (GAIL)

The Gas Authority of India is a state-owned oil and natural gas company headquartered in New Delhi. With over 4700 employees, it aptly lives up to its name as India's largest natural gas company, boasting a turnover of US$ 12 billion, and it stands as the premier gas utility in Asia. The company's considerable influence extends to similar industries, firmly securing its place among the finest Indian Oil and Gas Companies. Recognized for its prowess, it achieved Maharatna status in 2013 as conferred by the Government of India. Established in 1984, it was ranked 81st in the Top 250 Global Energy Companies Ranking.

2. Literature review

The present literature review focuses on three main constructs of interest in the context of this proposed research: Energy Management (EM), Energy Efficiency (EE), and Sustainable Development Goal (SDG).

2.1 Energy Management

Nguyen, Lam, & Nguyen (2023): This study focused on middle-income nations between the years 1994 and 2014 in order to determine the causal relationship between economic growth development financing and energy usage. The results of this study show that there is a one-way causal relationship between economic growth and overall energy consumption, as well as a one-way relationship between financial development and overall energy consumption, a one-way relationship between financial development and renewable energy consumption, and a one-way relationship between non-renewable energy consumption and economic growth. The study made some ground-breaking recommendations for optimal energy management in smart cities towards sustainable development, balancing economic growth and energy consumption, based on empirical data.

Heydari, Heydari, & Amini (2023): In this study, the researcher presented the conceptual review of existing literature on energy management techniques, renewable energy sources, and

current energy consumption trends. As part of the research approach, case studies and recent studies were reviewed, and the efficacy of various energy management and renewable energy solutions were examined. The contemporary findings of the literature presented in this study revealed that an integrated strategy that incorporates energy management techniques and renewable energy sources can dramatically lower energy use and greenhouse gas emissions while also bringing about financial gains. To achieve sustainable and effective energy use, the conclusion emphasises the significance of the adoption of an integrated strategy for energy management and renewable energy sources.

Yücel (2022): The aim of this paper was to provide a theoretical explanation of the influence of energy consumption on business performance. Energy management was approached as a strategic application encompassing various measures and management practices, including technical systems, systematically implemented to minimize energy usage within an organization, thereby positively affecting business performance. Business performance, in turn, encompassed factors such as efficiency, quality, customer satisfaction, employee satisfaction, and profitability.

Halis and Halis (2021): This study focused on uncovering the interconnected and serially mediated relationship between EMS and firm performance, facilitated by pro-environmental energy consumption (PEC) and pro-environmental energy consumption performance (PECP) while considering the moderating influence of environmental awareness (EA). Data collected from a sample of industrial Turkish firms (n = 189) were subjected to analysis using the partial least squares structural equation modeling (PLS-SEM) technique.

Patel, Shah, & Trivedi (2021): This study emphasizes the importance of energy efficiency in industries through the adoption of energy management practices (EMPs), which includes the integrated framework linking EMPs, environmental and financial performance, with energy efficiency and audit acting as mediating factors. The research uses structural equation modelling and Hayes' process for moderation effects, revealing that energy efficiency acts as a mediator between EMP implementation and environmental performance, with strong top management commitment enhancing the impact. Energy audits also mediate the link between EMPs and

energy efficiency. The study highlights the complex interplay between energy management strategies, environmental and financial outcomes, and the pivotal role of top management commitment and energy audits in enhancing energy efficiency and overall performance in manufacturing firms.

Hossain et al. (2020): The study analysed the energy management practices prevailing in the cement industry of Bangladesh, and revealed that barriers such as lack of staff consciousness, government insufficient attention, and bureaucratic intricacy, which resulted in inefficient energy management intermediation include high energy prices, motivated employees, and high demand from consumers and non-government organizations. Furthermore, the results of the study suggested that enhanced energy efficiency can be achieved with effective energy management practices, but many industries lack information and competent human resources.

Nakthong and Kubaha (2019): This study emphasized, an innovative approach to evaluate energy management quality through an energy management system sustainability index (EnMS SI) framework. This framework encompassed economic, organizational, energy performance, and environmental dimensions of sustainable energy management. Sustainability indicators were chosen using data from literature reviews and EnMS best practices, leading to the development of the EnMS SI. The analytic hierarchy process (AHP) and weighted arithmetic mean (WAM) were employed to establish this index. The study's effectiveness was confirmed by assessing 31 ISO 50001-certified companies in Thailand, involving direct interviews and questionnaires with energy management representatives. The findings demonstrated the EnMS SI framework's capability in qualitatively analysing and gauging the sustainability of energy management systems.

Fernando et al. (2018). The study highlights the linkages between insufficient energy efficiency knowledge and challenges faced by firms in effective energy management. Sharing knowledge and technology from multinational to local companies could enhance energy usage and harness renewable energy through supply chain networks. The research highlights the need for a comprehensive dialogue on integrating energy management and renewable energy supply chains. The study explores the influence of energy management practices (EMP) on renewable

energy supply chain initiatives within 151 certified manufacturing firms in Malaysia. The study finds a positive correlation between top management commitment, energy awareness, and energy auditing, suggesting proactive energy management practices, driven by committed leadership, heightened awareness, and rigorous auditing, play a pivotal role in promoting renewable energy supply chain initiatives within certified manufacturing firms.

Fernando & Hor (2017): This study delved into the existing energy management practices within Malaysian manufacturing firms, focusing on ISO 14000-certified entities. The findings underscored the nascent stage of energy management practices and a restricted emphasis on carbon emissions within the Malaysian manufacturing landscape. Despite a general lack of competitive impetus for environmentally conscious management approaches, marginal enhancements in energy management and efficiency were observable. Notably, energy audit and efficiency emerged as pivotal factors in curtailing carbon emissions. Moreover, the study highlighted the interconnection between energy awareness, knowledge, commitment, and energy efficiency.

Sa, Thollander, & Cagno (2017): This study examined the adoption of energy investment through compliance with financial analysis and choosing the investments through contextual organisational factors (e.g., organisational energy culture, power relationships, energy management system, expertise availability, managers' mindset), along with characteristics of the energy management programme, as two macro perspectives in energy efficiency literature.

Schulze et al. (2016): This paper systematically reviewed published academic journal articles focusing on energy management in industrial settings. Within the literature, five fundamental key elements of energy management were discerned based on overarching themes: strategy/planning, implementation/operation, controlling, organization, and culture. The specific insights pertaining to each key element were synthesized. Subsequently, a conceptual framework for energy management was formulated, highlighting the need for a comprehensive approach to tap into the available energy efficiency potential effectively.

Müller et al. (2013): This study emphasises the interaction between energy management and energy efficiency and by this, the meaning of energy management as an integral part of energy-

efficient factories was underlined. Energy management is typically applied during factory operations to enhance energy performance, encompassing improvements in energy efficiency, security of energy supply, and optimized energy utilization and consumption. Moreover, the incorporation of energy-related responsibilities within the factory planning process should ideally be implemented, encompassing facets such as energy procurement, distribution, storage, and utilization – fostering a more methodical and comprehensive integration of energy efficiency within a company's organizational and technical workflows.

Wallis et al. (2005): The research paper highlighted the misconception that 'community engagement' often wrongly included activities like service and consultation. It clarified that genuine engagement is rooted in productive partnerships benefiting both universities and communities, leading to regional growth, research advancements, and human capital development. Collaborative partnerships are crucial for sustainable progress, with universities playing a significant role through skilled graduates, research, best practices, and partnerships. Case studies showcased how such engagement fostered substantial sustainability progress, serving the interests of various stakeholders effectively.

2.2 Energy Efficiency

Knayer and Kryvinska (2023): This study aimed to assess the current energy efficiency status in companies through a case study involving 386 diverse industries. The data collection involved questionnaires, interviews, and expert visits, all part of the EU-funded Network of Regional Competence Centers for Energy Efficiency project. The focus was on specific cross-cutting technologies. Future research recommendations include investigating how various efficiency measures interact within companies to better understand their needs and develop effective support programs.

Rahman and Islam (2023). This study aims to investigate the relationship between green accounting energy efficiency and environmental performance. The study also explores the mediating role of energy efficiency in the relationship between green accounting and environmental performance. A total of 326 responses were collected using a simple random sampling technique. The study employed Partial Least Squares Structural Equation Modeling

(PLS-SEM) to analyze the data. The results indicate that green accounting has a significant positive impact on both energy efficiency and environmental performance. Moreover, energy efficiency partially mediates the relationship between green accounting and environmental performance. The study also found that economic, environmental, and social practices of green accounting have a positive impact on both energy efficiency and environmental performance, with environmental practices having the highest impact.

Chien (2022): The research study investigates how increased energy efficiency functions as a mediator at the intersection of the SDGs, lower energy prices, higher energy resource efficiency, and acceptable use of energy resources. This study uses questionnaires, as its main data collection method to gather information from chosen respondents, the managers of manufacturing enterprises. The study uses Smart-PLS to examine the item reliability and determine whether the factors are related. The findings show that in China's industrial sector, the SDGs are positively correlated with energy resource efficiency improvements, cost reductions, and reasonable energy use.

Zhang et al. (2022): The study analyses the relationship between the digital economy, energy efficiency, and carbon emissions in China between 2012 and 2019. Results show that the growth of the digital economy contributes to increased carbon emissions, with energy efficiency playing a crucial role as a partial mediator. However, the digital economy's development doesn't necessarily enhance energy efficiency, leading to higher carbon emissions. Energy efficiency accounts for around 30.58% of the total effect of the digital economy on carbon emissions. Factors like population size, energy consumption structure, and industrial composition also influence carbon emissions. Optimizing the digital economy's level and quality and implementing tailored development policies based on energy efficiency are essential for achieving meaningful carbon emission reduction.

Zakari et al. (2022). This study attempts to connect Sustainable Development Goals (SDGs) with energy efficiency for 20 Asian and Pacific (AP) countries using Data Envelopment Analysis (DEA) from 2000 to 2018. The Panel Correction Standard Error (PCSE) estimates found that sustainable economic development and energy efficiency are positively related,

suggesting that sustainable economic development is associated with increased energy efficiency. Similarly, we found that sustainable financial development is also positive, indicating that sustainable financial development increases energy efficiency. In further analyses, researchers confirmed a positive impact of green innovation on energy efficiency. The S-GMM estimator confirmed similar findings, showing robust to alternative econometric model.

Hasan et al. (2021): In this study, an empirical investigation was conducted on energy efficiency and management practices in Bangladesh's energy-intensive industries. The study found that most companies barely implement energy management practices, with energy audits being the most commonly implemented. A comprehensive approach is still lacking, and the number of dedicated energy professionals is negligible. Insufficient support from top administration and bureaucratic intricacy hinders energy efficiency. Energy blueprint cost-saving and rules and regulations are crucial drivers for energy efficiency, but lack of information is a significant barrier to consulting energy service companies. The study highlights insufficient energy efficiency measures and management practices in Bangladesh and suggests that 8%-10% improvement could be achieved through energy management practices. These findings pave the way for further research on industrial energy efficiency in developing countries.

Yu, Zhu, & Nian (2021): This study uses the System Generalised Method of Moments (SYS-GMM) to investigate the impact of energy efficiency and corruption affect industrial carbon emissions. The findings show that, under the conditions of present economic development, the effects of corruption and energy efficiency on industrial carbon emissions are the opposite, i.e., corruption can increase emissions while energy efficiency makes it easier to reduce emissions. Both the overall sample and the sub-sample relationship between corruption and carbon emissions are mediated by energy efficiency. So, by reducing energy efficiency, corruption increases industrial carbon emissions. A U-shaped association between energy efficiency and carbon emissions and an inverted U-shaped relationship between corruption and carbon emissions also exist in the eastern part of China.

Tachmitzaki, et al. (2019): This study focuses on identifying and analysing crucial factors

influencing the successful implementation of effective energy management practices in Greek enterprises. A survey using questionnaires was conducted from May to September 2016, receiving 132 responses out of 649 sent (a 20.3% response rate). Key findings highlight that the implementation of a structured and integrated energy management system significantly enhances energy management in Greek enterprises. The use of modern technology, employee involvement, and senior management commitment are also found to be essential determinants for successful energy management implementation in business operations.

Munro et al. (2017): This paper contested the fundamental orientation of this approach, asserting that it posed challenges to achieving energy justice and equitable development. Firstly, by framing the global energy distribution issue in broad techno-managerial terms, it concealed the role of significant political-economic factors in shaping specific energy poverty patterns. Secondly, the approach's emphasis on modern energy forms and the universal attainment of an end-state neglected the broader objective of eradicating energy poverty, potentially posing risks to the well-being of the intended beneficiaries.

Sivill et al. (2012): This study delved into the developmental focus within the energy-intensive industrial sector, specifically examining the significance of energy performance measurement. This sector represents an advanced stage in its energy management learning curve. The research also pinpointed the essential research and development requirements for enhancing energy performance measurement further. The findings emerged from interviews with managers and operators across three energy-intensive industrial sectors in Finland. Remarkably, energy performance measurement emerged as the third developmental priority in energy management, following resource and commitment concerns. This reveals a paradox, as the resources and commitment are prerequisites for the advancement of energy performance measurement, which, in turn, influences these very same factors by promoting altered behaviour.

Halldorsson and Kovács (2010): This study aimed to explore climate change's present and future consequences, specifically focusing on energy efficiency within logistics and supply chain management (SCM). A conceptual framework was devised to examine the immediate and practical impacts of adopting a sustainable approach to SCM and logistics. Energy efficiency

has been significantly overlooked in these fields. Simultaneously, incorporating energy efficiency demanded substantial reconsideration at operational levels, encompassing aspects like transportation emissions and the cold chain, as well as at a conceptual level. This underscored the necessity for further developing logistics theory and practice in alignment with energy-related objectives.

2.3 Sustainable Development

Borges et al. (2022): This study analysed the sustainable practices of major oil and gas companies in Latin America. The authors analysed the sustainability reports of 7 of the 10 largest oil and gas companies in the region, which were published in 2020. They found that these companies reported a total of 244 sustainable practices. These practices were summarized into 20 keywords, and the authors related them to the Sustainable Development Goals (SDGs) 7, 9, 11, and 12.

Obaideen et al. (2022): This study assesses biogas's role in advancing the Sustainable Development Goals (SDGs) and its implementation at domestic and industrial levels. It compares biogas with fossil fuels, highlighting their merits and drawbacks. Biogas significantly contributes to 12 out of 17 SDGs, enhancing renewable energy generation, mitigating climate change, optimizing waste management, and fostering employment opportunities. A set of 58 indicators is proposed to guide stakeholders in the biogas sector, aligning benefits with SDG attainment while minimizing trade-offs.

Sadiq et al. (2022): This article examines the effects of economic growth, environmental, social, and governance (ESG), and governance on the SDG of ASEAN nations. The World Development Indicators (WDI) from 1986 to 2020 and SDGs reports are some of the secondary sources from which the current study has taken secondary data. To examine the relationship between the variables in the current study, the Panel Autoregressive Distributed Lag (ARDL) method was used. The findings showed a positive correlation between the SDGs of the ASEAN countries and the environmental, social, governance, and economic growth scores.

Olugu et al. (2022): This study aims to integrate maintenance and sustainability themes into the O&G industry's performance assessment methodology. In this study, it was suggested to

evaluate sustainability on offshore production and drilling platforms using a variety of performance metrics. The four sustainability-related parts of the conceptual framework are broken down into technical, environmental, social, and economic dimensions. Each metric was assigned based on how important it was for maintenance decision-making at the strategic, tactical, and functional levels. Twelve strategic indicators were grouped hierarchically as a result of the conceptual framework. These indicators include both traditional and modern assessments of the dependability and safety of offshore platforms. The present study's potential contribution can be found in its goal to advance knowledge of sustainable maintenance and inspire people who are making choices regarding its practical use in the oil and gas sector.

Cai et al. (2021): This study examines the effects of agriculture, urbanisation, economic development, non-renewable energy consumption, and renewable energy consumption on CO2 emissions for a few South Asian economies between 1990 and 2018. completely modified ordinary least squares method, and analysis of variance decomposition. Empirical findings show that agriculture and renewable energy consumption. reduce carbon emissions and renewable energy. and urbanisation worsens environmental degradation. Additionally, the results support the E.K.C. hypothesis in South Asian nations. Based on the findings, a comprehensive SDG-oriented policy framework has been proposed, which might assist these economies in fulfilling the key objectives of SDGs 13, 7, 8, 11, and 02, as well as SDGs 13, 7, 8, and 9. This study adds to the existing body of literature by proposing an S.D.G.-focused policy approach.

Elavarasan et al. (2021): This study investigates the impact of environmental, social, and governance (ESG) and economic growth on the SDG of ASEAN countries. The current study has extracted secondary data from secondary sources such as SDGs reports and World Development Indicators (WDI) from 1986 to 2020. The study used the Panel Autoregressive Distributed Lag (ARDL) to test the linkage among the variables. The results highlighted that the environmental score, social score, governance score, and economic growth positively associated with the ASEAN countries' SDGs. The current article provides help to new researchers while conducting research on achieving SDGs and guides policymakers while establishing policies regarding achieving the SDGs through ESG.

Santika et al. (2020): This study aimed to create an innovative Energy Sustainability Composite Index for Sustainable Development Goal 7 (SDG 7) to evaluate energy sustainability performance. The focus was on Europe, encompassing 40 countries chosen based on data availability for energy sustainability assessment. The study evaluated aspects such as clean energy conversion, energy security, accessibility, intensity, and carbon intensity. The findings revealed that Iceland, Norway, and Sweden excelled in energy sustainability, scoring 0.7313, 0.6967, and 0.6313 (on a scale of 0 to 1). Additionally, the newly proposed composite index was compared with the official SDG 7 index, which incorporates indicators outlined by the United Nations.

Tucho and Kumsa (2020): The study focused on Sustainable Development Goal 7 (SDG 7), which aimed to ensure universal access to affordable, reliable, sustainable, and modern energy by 2030. This objective exhibited numerous synergies and connections with other SDGs, particularly highlighting links with goals 1, 3, 4, 5, and 15. However, achieving this goal, especially in terms of making affordable and sustainable modern cooking energy accessible, posed considerable challenges, exacerbated by previous unsuccessful initiatives.

Awan et al. (2014): This study aimed to investigate the noteworthy practices and initiatives implemented by corporations in the realm of energy management, emphasizing their role in fostering sustainable development. Additionally, the study aimed to spotlight shortcomings in the formulation of energy policies and goal-setting processes, which hindered the enhancement of human living standards and contributions to sustainable development. Addressing contemporary challenges in energy management, this research employed an exploratory approach grounded in an extensive review of existing literature on energy management, efficiency improvement, and optimal cost reduction methods adopted by organizations. The findings strongly underscored the necessity of adopting a systematic approach for achieving sustainable development.

3. Need of the study

The study aims to address the imperatives of enhancing energy management within the oil and gas sector of India to promote sustainable development. The oil and gas sector plays a vital role

in global economic growth and energy supply, coupled with its environmental and social impacts, there is a pressing need to explore strategies for improving energy efficiency and conservation. The attainment of sustainable development goals is highly mediated by the imperatives of balanced economic growth and environmental protection. Thus, the proposed study shall seek to identify the potential for the enhancement of energy efficiency through the effective use of Energy Management Practices integrated with the strategic framework of Sustainable Development, leading to a reduction in the industry's waste and enhancement of operational efficiency, cost savings, and competitiveness. Ultimately, the present study shall aim to provide a deeper insight into energy management in the oil and gas sector, which may guide policy development, inform industry practices, and contribute to a more sustainable energy future.

4. Research gaps

The researcher has identified the select potential research gaps based on the literature review suggesting that in past studies the major emphasis was on studying the relationship between Energy Management Practices (EMP), Environmental Audit (EA), and Organizational Performance (OP), revealing that energy management practices lower the carbon footprint of industrial units. Moreover, the domain of the past studies failed to address the other issues that remain unaddressed in the previous studies as stated below:

- An in-depth exploration of existing literature has been conducted to pinpoint several areas where research gaps exist. By examining a substantial body of literature, it becomes evident that there is a notable lack of understanding when it comes to how social, economic, and environmental factors interplay and affect the successful attainment of sustainable development goals.
- More study is required to comprehend how energy management systems affect workers, nearby communities, and the economy on a social, environmental, and economic level. There is a lack of research on the factors affecting energy management strategies, particularly for manufacturing facilities within the oil and gas industry, which are crucial to energy management efforts because they affect energy consumption, efficiency, and

environmental impact throughout the sector's value chain. By implementing sustainable energy management techniques, these facilities support the industry's overarching objectives of lowering environmental impact, boosting efficiency, and encouraging responsible resource use.

- Even though various studies have emphasised the drivers and challenges of energy management practises in industrial units, further research is still required to establish the variables that the implementation of energy management practises depends on. A study is required to examine the long-term effects of energy management practices on carbon emissions and the environment.

5. Problem Statement

The proposed study shall focus on establishing the relationship between energy management and sustainable development based on the exploration of the mediating effect of energy efficiency on the relationship between energy management and sustainable development in selected areas of this proposed study.

6. Research Questions

The following research issues shall be addressed to fill the above-stated research gaps:

- What is the impact of Energy Management on Achieving Sustainable Development in selected Oil and gas companies?
- What is the impact of Energy Management on Energy Efficiency in selected Oil and gas companies?
- Does Energy Efficiency mediate the relationship between Energy Management and Sustainable Development in Selected Oil and gas companies?
- What are the dimensions affecting the implementation of Energy Management?

7. OBJECTIVES OF THE STUDY

The proposed study addresses to seek the following objectives:

Objective 1: To assess the impact of Energy Management on Sustainable Development.

Here, we propose to assess the impact of Energy Management on Sustainable Development in the Oil and Gas sector of India.

Objective 2: To evaluate the impact of Energy Management on Energy efficiency.

Here, we propose to evaluate the impact of Energy Management on Energy efficiency in the Oil and Gas sector of India.

Objective 3: To measure the mediating effect of Energy Efficiency on the relationship between Energy Management and Sustainable Development.

Here, we propose to explore the mediating effect of Energy Efficiency on the relationship between Energy Management and Sustainable Development Goals in the Oil and Gas sector of India.

Objective 4: To propose a strategic action plan for effective Energy Management.

Here, we propose a strategic action plan for effective energy management in the Oil and Gas sector of India.

8. Conceptual Framework and Research Hypotheses

The proposed conceptual framework evolved after an exhaustive literature review, and the variables have been selected accordingly. This proposed conceptual framework represents the impact of energy management (social dimensions, economic dimensions, and environmental dimensions) on sustainable development. Energy efficiency will be tested for its mediating effect on the relationship between energy management and sustainable development. The mediating effect of energy efficiency on the relationship between energy management and sustainable development signifies that proficient energy management practices lead to enhanced energy efficiency, which directly contributes to the environmental, economic, and social dimensions of sustainable development. Energy efficiency acts as a vital intermediary, translating effective energy management efforts into tangible benefits such as reduced emissions, cost savings, improved air quality, and societal well-being, thus reinforcing the connection between energy management strategies and broader sustainability goals. Here, energy management is taken as an independent variable, energy efficiency as a mediating variable, and sustainable development as a dependent variable, respectively.

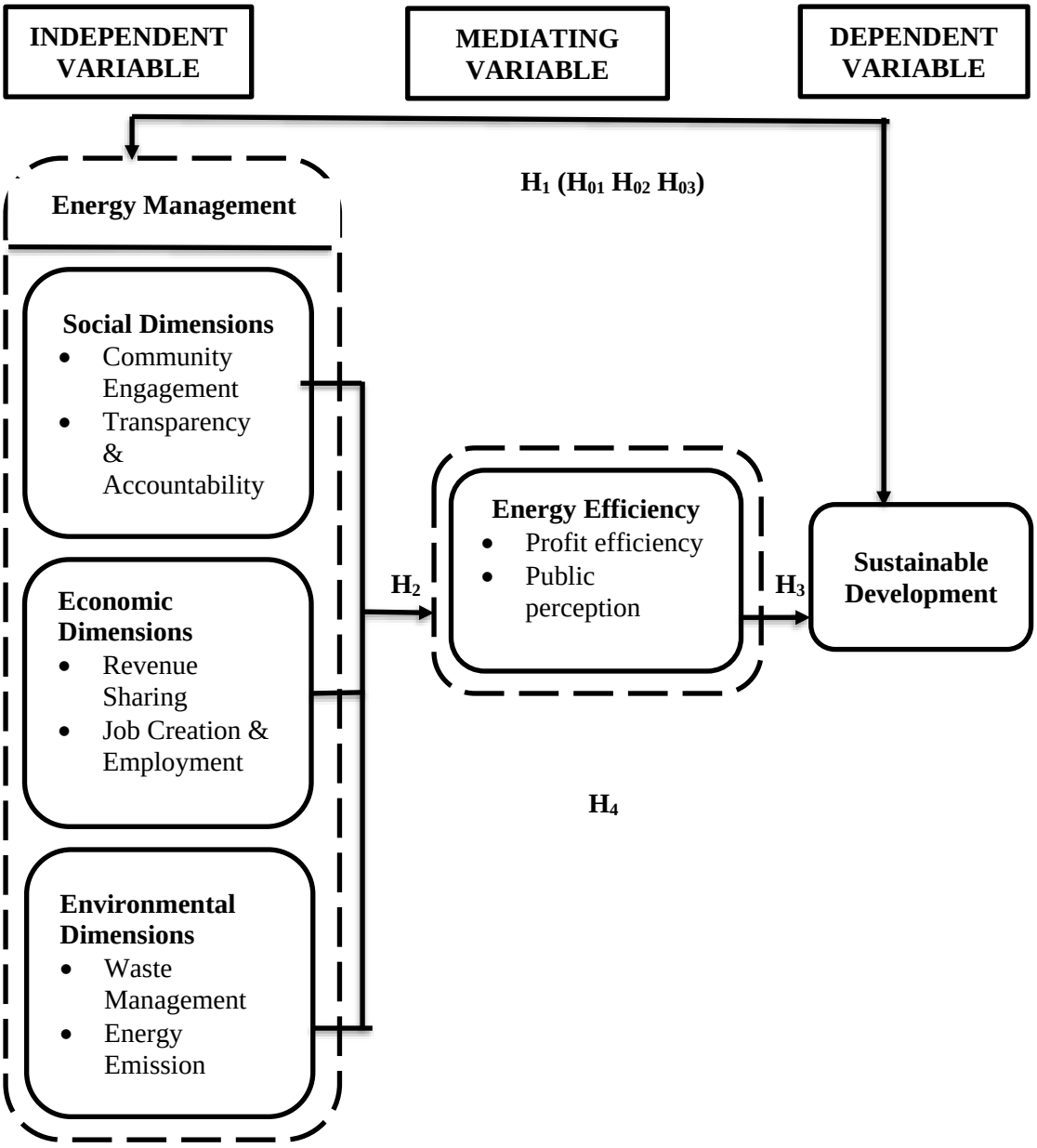

Figure 2: Conceptual Model
(Source: Author's Compilation)

8.1 Hypotheses

The study will be carried out to test the following hypotheses. The hypotheses for the study are designed based on relevant literature.

8.1.1 Social Dimensions of Energy Management and Sustainable Development

According to (Olugu et al., 2022) encompasses various critical facets such as health, safety,

social equity, and security. These dimensions encapsulate the essential elements that are pivotal to the overall welfare and sustainable development of both individuals and communities affected by the industry.

H_{01}: There is no significant relationship between social dimensions and sustainable development.

8.1.2 Economic Dimensions of Energy Management and Sustainable Development

The Economic practices of energy management refer to the integration of environmental and social factors. According to Geng et al. (2017), The economic practice of energy management involves economic benefits and costs associated with a company's environmental and social impact. (Christine, 2019) cites both the economic benefits of sustainable practises, such as energy efficiency or reduced resource consumption, as well as the costs of minimising environmental effects, such as investing in clean technologies or decreasing trash.

H_{02}: There is no significant relationship between economic dimensions and sustainable development.

8.1.3 Environmental Dimensions of Energy Management and Sustainable Development

Kang et al., (2018), The Environmental practices of energy management involve measuring, monitoring, and reporting an organisation’s environmental impact and performance. Gao and Peng, (2022), Environmental practices are an important aspect of energy management, as they help organizations minimize their environmental impact and contribute to a more sustainable future.

H_{03}: There is no significant relationship between environmental dimensions and sustainable development.

8.1.4 Energy Efficiency plays a mediating effect in the relationship between energy management and sustainable development

The mediating effect of energy efficiency has been explored in the context of various industries and sectors, including waste-to-energy, fertilizer, digital economy, power sector, and industrial carbon emissions. Yu et al. (2021) found that energy efficiency mediates the relationship between corruption and industrial carbon emissions in China. Similarly, Zhang et al. (2022)

showed that the digital economy has a positive impact on energy efficiency, and the relationship is mediated by technological progress and structural transformation. Moreover, Gao and Peng (2022) examined the mediating effect of energy efficiency on the relationship between air quality ranking, digital economy, and energy-saving and emission reduction in China. The studies highlight the importance of energy efficiency as a crucial factor in promoting sustainable development and reducing environmental impact, which can be achieved through the implementation of energy management (Iredele et al., 2020).

H_{04}: There is no significant mediating effect of energy efficiency on the relationship between energy management and sustainable development

- **H_{04a}: There is no significant mediating effect of profit efficiency on the relationship between energy management and sustainable development**
- **H_{04b}: There is no significant mediating effect of public perception on the relationship between energy management and sustainable development**

9. Research Methodology

9.1 Research Design

The proposed research shall be descriptive and analytical in nature.

9.2 Scope of the study

The scope of the study will be confined to selected Oil and Gas sector companies in India.

9.3 Sampling Design

The proposed study shall use Purposive sampling to select the target respondents using a semi-structured questionnaire administered over the sample population, as the chosen respondents will be able to provide specific knowledge about the topic of study. Purposive sampling enables researchers to focus on particular features or skills pertinent to the research subject.

9.4 Sample Frame

The sample units for the given study will comprise employees from select Oil and Gas companies in India. A semi-structured questionnaire will be circulated to the respondents for data collection. A sampling frame can be defined as a list of elements from which a sample may be drawn. The target population is the employees in India. The following table shows the total number of employees in select Oil and Gas sector companies in India.

Table 2: Total number of Employees in select Oil and Gas Sector companies

Oil and Gas Company	Total No. of Employees	Web links
Bharat Petroleum Corporation Limited	12157	https://www.bharatpetroleum.com/
Gas Authority of India Limited	4704	https://gailonline.com/home.html
Indian Oil Corporation Limited	31648	https://www.iocl.com/
Oil and Natural Gas Corporation Limited	27165	ONGC - India's Largest Crude Oil and Natural Gas Corporation Limited Company - en - ongcindia.com
Hindustan Petroleum Corporation	9696	https://www.hindustanpetroleum.com/
TOTAL EMPLOYEES	85370	

(Source: Homepage of Websites)

The total number of employees from select Oil and Gas companies in India namely-

1. Bharat Petroleum Corporation Limited
2. Gas Authority of India Limited
3. Indian Oil Corporation Limited
4. Oil and Natural Gas Corporation Limited
5. Hindustan Petroleum Corporation

Based on the sample size determination, the number of respondents to be taken from each company is computed based on the percentage proportion method. The following table shows the calculation of the number of employees from select Oil and Gas companies.

Table 3: Number of Employees from each select Oil and Gas sector Company

Oil and Gas Company	Number of Employees to be selected
Bharat Petroleum Corporation Limited	(12157 / 85370) x 340 =48
Gas Authority of India Limited	(4704 / 85370) x340= 19
Indian Oil Corporation Limited	(31648 / 85370) x 340 = 126
Oil and Natural Gas Corporation Limited	(27165 / 85370) x 340 = 108
Hindustan Petroleum Corporation Limited	(9696 / 85370) x 340 =39
Total number of employees	**340**

(Source: Computation based on percentage proportion method)

9.5 Sample Size

The population from which the sample needs to be drawn is infinite. If a population is higher than 50,000, it is said to be infinite. Therefore, the sample size has been calculated using the sample size formula for the infinite population through a precision rate and confidence level

approach to arrive at a representative number of respondents (Godden, 2004).

Where, SS= Sample size for the infinite population (Godden, 2004)

Z= Z value

$$SS = Z2 \times (p) \times (1-p)\ C2$$

p= Population proportion

C = Margin of Error at 5% (0.05) **(**Equation 1**)**

To minimize the bias and obtain a realistic sample size, three scenarios are evaluated-

Scenario I Estimating 10% of the population with a 6% Margin of Error

Scenario II Estimating 30% of the population with a 5% Margin of Error

Scenario III Estimating 50% of the population with a 4% Margin of Error

Table 4: Calculation of Sample Size

Scenario	Population Proportion	Value of Z (95% Confidence Level)	Error of Margin	Sample Size Calculation	Sample Size
I	10%	1.96	0.06	$=\frac{1.96^2\ 0.1(1-0.1)}{0.06^2}$	96
II	30%	1.96	0.05	$=\frac{1.96^2\ 0.3(1-0.3)}{0.05^2}$	323
III	50%	1.96	0.04	$=\frac{1.96^2\ 0.05(1-0.5)}{0.04^2}$	600
				Total Average	1019 340

(Source: Computed by means of using the Godden formula (equation -1))

Therefore, the sample size for the study will be **340.**

9.6 Sources of Data Collection

Both primary and secondary methods of data collection will be used.

9.6.1 Primary Data

Primary data will be collected by using semi-structured Questionnaires. The researcher will have an open-ended questionnaire which will enhance the chances to gain a better insight into the psychology of the respondents. There will be a set of questions that will have to be filled by the respondents by themselves and hence it will give the researcher a better rendition of the core problems of research.

9.6.2 Secondary Data

Concerning the dynamic nature of the research, the researcher will be using the Annual Reports

of selected Oil and Gas sector companies, Websites, Market Research Reports, Books, Magazines, Journals, and Blogs, Other published and unpublished sources for the collection of secondary data.

9.7 Statistical Tools

To test the given hypotheses and survey findings scientifically, the researcher will analyse the data by using appropriate statistical tools like ANOVA (analysis of variance), Correlation analysis, Regression analysis, Partial Least Square and Structural Equation Modelling (PLS-SEM) to test the mediating effect.

Table 5: Summary of proposed analysis tools

Type of Method	Questionnaire, Case Study
Type of Study	Descriptive and Analytical
Population	85370
Type of Population	Infinite
Sampling Frame	Selected employees of the Oil and Gas sector
Sampling Method	Purposive sampling
Statistical Tools & Techniques	ANOVA, Correlation analysis, Regression analysis, Smart-PLS, and Structural Equation Modelling (SEM)
Sample Size	**SS = Z2 x (p) x (1-p) C2** Where, SS= Sample size for the infinite population (Godden, 2004) Z= Z value p= Population proportion C = Margin of Error at 5% (0.05) Therefore, the sample size for the study will be **340.**

10. Implications of the Study

The present study helps determine the relationship between energy management, energy efficiency, and sustainable development. Focusing on waste management efforts, energy companies can efficiently reduce carbon emissions, minimize expenses, and enhance overall operational efficiency. By informing policymakers, the study can prompt the creation of regulations that encourage environmentally conscious practices within the industry. Concurrently, it empowers industry bodies to develop optimized energy management protocols, thereby making a substantial contribution to the comprehension of energy dynamics within this sector. Ultimately, these findings hold the potential to amplify both environmental sustainability and overall sustainability in the energy industry.

11. Proposed Chapterization

The structure of the proposed study will be as follows:

Chapter 1: Introduction

Chapter 2: Review of Literature

Chapter 3: Research Methodology

Chapter 4: Analysis and Results

Chapter 5: Conclusions and Suggestions

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Appendix - I

Table 6: Literature Review Synthesized Matrix

S. No	Authors	Social Dimensions	Economic Dimensions	Environmental Dimensions	Energy Efficiency	Sustainable Development
1.	Awan et al. (2014)					√
2.	Borges et al. (2022)					√
3.	Cai et al. (2021)					√
4.	Chien F, (2022)				√	
5.	Elavarasan et al. (2021)					√
6.	Fernando & Hor (2017)	√		√		
7.	Fernando et al. (2018)	√	√	√		
8.	Halis & Halis (2021)		√			
9.	Halldórsson & Kovacs (2010)				√	
10.	Hasan et al. (2021)				√	
11.	Heydari et al. (2023)		√	√		
12.	Hossain et al. (2020)	√				
13.	Knayer & Kryvinska (2023)				√	

14.	Muller et al. (2013)	√		√		
15.	Munro et al. (2017)				√	
16.	Nguyen et al. (2023)		√			
17.	Nokthang & Kubaha (2019)		√	√		
18.	Obaideen et al. (2022)					√
19.	Olugu et al. (2022)					√
20.	Patel et al. (2022)		√			
21.	Rahman & Islam (2023)				√	
22.	Sa et al. (2017)		√	√		
23.	Sadiq et al. (2022)					√
24.	Santika et al. (2020)					√
25.	Schuzle et al. (2016)		√	√		
26.	Sivill et al. (2012)				√	
27.	Tachmitzaki et al. (2019)				√	
28.	Tucho & Kumsa (2020)					√
29.	Wallis et al. (2005)	√				
30.	Yu et al. (2021)				√	
31.	Yucel (2022)		√			
32.	Zakari et al. (2022)				√	
33.	Zhang et al. (2022)				√	